# Agency, IA

2015 Urban Forest Management Plan
Prepared by Ray Lehn
Bureau of Forestry, Iowa DNR

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Executive Summary_____

Overview

This plan was developed to assist the City of Agency with managing its urban forest, including budgeting and future planning. Trees can provide a multitude of benefits to the community, and sound management allows a community to best take advantage of these benefits. Management is especially important considering the serious threats posed by forest pests such as the emerald ash borer (EAB). EAB is an invasive insect imported from Eastern Asia on wood shipping crates that kills all species of ash trees (this does not include mountain ash). There is a strong possibility that 9.4% of Agency's city owned trees (ash) will die once EAB becomes established in the community, unless preventative treatment is used. With proper planning and management, the costs of removing dead and dying trees can be extended over years, mitigating public safety issues.

Inventory and Results

In 2014, a tree inventory was conducted using Global Positioning System (GPS) data collectors. The inventory was a complete inventory of street trees. Below are some key findings of the 107 trees inventoried.
- Agency's trees provide $15,321 of benefits annually, an average of $143 a tree
- There are over 27 species of trees
- The top three genera are: Maple 31.8%, Ash 9.4%, and Black Locust 9.4%
- 20% of trees are in need of some type of management
- 2 trees are recommended for removal

Recommendations

The core recommendations are detailed in the Recommendations Section. The Emerald Ash Borer Plan includes management recommendations as well. Below are some key recommendations.
- Of the 2 trees needing removal, 1 tree is over 24 inches in diameter at 4.5 ft and should be addressed immediately *City ownership of the trees recommended for removal should be verified prior to any removal*
- 5 of the 10 ash trees should be carefully examined, as they have one or more symptoms that could be related to an EAB infestation (canopy dieback)
- All trees should be pruned on a routine schedule- one third of the city every other year
- Plant a diverse mix of trees that do not include: ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut
- Check ash trees with a visual survey yearly
- It would take an annual budget of approximately $1,750 to remove all ash and critical/immediate concern trees, maintain existing trees, and plant replacement trees.

Introduction

This plan was developed to assist Agency with the management, budgeting and future planning of their urban forest. Across the state, forestry budgets continue to decrease with more and more of that money spent on tree removal. With the anticipated arrival of Emerald Ash Borer (EAB), an invasive pest that kills native ash trees, it is time to prepare for the increased costs of tree removal and replacement planting. With proper planning and management of the current canopy in Agency, these costs can be extended over years and public safety issues from dead and dying ash trees mitigated.

Trees are an important component of Agency's infrastructure and one of the greatest assets to the community. The benefits of trees are immense. Trees provide the community with improved air quality, stormwater runoff interception, energy conservation, lower traffic speeds, increased property values, reduced crime, improved mental health and create a desirable place to live, to name just a few benefits. It is essential that these benefits be maintained for the people of Agency and future generations through good urban forestry management.

Good urban forestry management involves setting goals and developing management strategies to achieve these goals. An essential part of developing management strategies is a comprehensive public tree inventory. The inventory supplies information that will be used for maintenance, removal schedules, tree planting and budgeting. Basing actions on this information will help meet Agency's urban forestry goals.

Inventory

In 2014, a tree inventory was conducted that included 100% of the city owned trees on streets. The tree data was collected using a handheld Global Positioning System (GPS) receiver. The data collector gives Geographic Information Systems (GIS) coordinates with an accuracy of 3 meters, which can be used in Arc GIS as an active GIS data layer. Because the inventory is a digital document the data can be updated with new information and become a working document.

The programming used to collect tree information on the data collectors was written to be compatible with a state-of-the-art software suite called i-Tree. i-Tree was developed by the USDA Forest Service to quantify the structure of community trees and the environmental services that trees provide. The i-Tree suite is a public domain which can be accessed for free.

To quantify the urban forest structure and benefits, specific data is collected for each tree. This data includes: location, land use, species, diameter at 4.5 ft, recommended maintenance, priority of that maintenance, leaf health, and wood condition. Additionally, signs and symptoms associated with EAB were noted for all ash trees. The signs and symptoms noted were canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Inventory Results_____

The data collected for the 107 city trees was entered into the USDA Forest service program Street Tree Resource Analysis Tool for Urban forestry Management (STRATUM), part of the i-Tree suite. The following are results from the i-Tree STRATUM analysis.

Annual Benefits

Annual Energy Benefits

Trees conserve energy by shading buildings and blocking winds. Agency's trees reduce energy related costs by approximately $4,173 annually (Appendix A, Table 1). These savings are both in Electricity (19.9 MWh) and in Natural Gas (2,715.4 Therms).

Annual Stormwater Benefits

Agency's trees intercept about 201,532 gallons of rainfall or snow melt a year (Appendix A, Table 2). This interception provides $5,462 of benefits to the city.

Annual Air Quality Benefits

Air quality is a persistent public health issue in Iowa. The urban forest improves air quality by removing pollutants, lowering air temperature, and reducing energy consumption, which in turn reduces emissions from power plants, and emitting volatile organic matter (ozone). In Agency, it is estimated that trees remove 252.4 lbs of air pollution (ozone (O_3), particulate matter less than 10 microns (PM10), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2)) per year with a net value of $710 (Appendix A, Table 3).

Annual Carbon Benefits

Carbon sequestration and storage reduce the amount of carbon in the atmosphere, mitigating climate change. In Agency, trees sequester about 49,405 lbs of carbon a year with an associated value of $371 (Appendix A, Table 5). In addition, the trees store 732,139 lbs of carbon, with a yearly benefit of $5,491 (Appendix A, Table 4).

Annual Aesthetics Benefits

Social benefits of trees are hard to capture. The analysis does have a calculation for this area that includes: aesthetic value, property values, lowered rates of mental illness and crime, city livability and much more. Agency receives $4,634 in annual social benefits from trees (Appendix A, Table 6).

Financial Summary of all Benefits

According to the USDA Forest Service i-Tree STRATUM analysis, Agency's trees provide $15,321 of benefits annually. Benefits of individual trees vary based on size, species, health and

location, but on average each of the 107 trees in Agency provide approximately $143 annually (Appendix A, Table 7).

Forest Structure

Species Distribution

Agency has over 27 different tree species along city streets and parks (Appendix A, Figure 1). The distribution of trees by genera is as follows:

Maple	34	31.8%
Ash	10	9.4%
Black Locust	10	9.4%
Redbud	7	6.5%
Apple (Crab)	6	5.6%
Northern white cedar	5	4.7%
Red cedar	5	4.7%
Walnut	4	3.7%
All other trees	26	24.2%

Age Class

Most of Agency's trees (55%) are between 6 and 18 inches in diameter at 4.5 ft (Appendix A, Figure 2). Only 14% are under 6 inches, while 31% are over 18 inches in diameter. For age, it is preferred that the highest amounts of trees are in the smallest size category (a downward slope) to prepare for natural mortality and to maintain canopy cover. Agency's size curve is on the larger side, indicating an older than average stand.

Condition: Wood and Foliage

Both wood condition and leaf condition are good indicators of the overall health of the urban forest. The foliage condition results for Agency indicate that 95% of the trees are in good health, with only 1% of the foliage in poor health, dead or dying (Appendix A, Figure 3 & Appendix B, Figure 3). Similarly, 82% of Agency's trees are in good health for wood condition (appendix A, Figure 4 & Appendix B, Figure 3). Wood condition that is in poor health, dead or dying is about 2% of the population. This 2% are trees that need management follow up.

Management Needs

The following outlines the specific management needs of the street trees by number of trees and percent of canopy (Appendix B, Figure 3).

Crown Cleaning	18	17%
Tree Removal	2	2%
Crown Reduction	2	2%

Canopy Cover

The total canopy with both private and public trees is 29%, which equals about 120 acres of Agency's 415 acres. The canopy cover included in the Agency inventory includes approximately 2.17 acres (Appendix B, Figure 5).

Land Use and Location

The majority of Agency's city trees are in planting strips in single family residential neighborhoods (Appendix A, Figure 6 & Appendix A, Figure7). The following describes the land use and locations for the street trees.

Land Use
Single family residential   75%
Park/vacant/other   24%
Small commercial   1%

Location
Planting strip   40%
Front yard   60%

Recommendations _____

Risk Management

Hazardous trees can be a significant threat to both people and property. Trees that are dead or dying, or that have large issues such as trunk cracks longer than 18 inches should be removed. Broken branches and branches that interfere with motorist's vision of pedestrians, vehicles, traffic signs and signals, etc should be removed.

Hazardous trees
Agency has 2 immediate concern trees that need removal. These trees can be seen on the Location of Trees with Recommended Maintenance map (Appendix B, Figure 4). It is recommended to start with the large diameter critical concern trees first. There is 1 tree over 24 inches in diameter at 4.5 ft that should be addressed immediately. Please refer to the six year maintenance plan at the end of this section. After all of the critical concern trees are addressed, there should be follow up on the trees marked as needing maintenance. There are a total of 22 trees with these needs.

Poor tree species
After the removal of the critical concern trees, ash trees in poor health should be assessed for removal (Appendix B, Figure 3 & Appendix B, Figure 4). Of the 2 removals, 1 is an ash tree. There are a total of 10 ash trees, and 5 of those have signs and symptoms that have been

associated with EAB. In addition, there is 1 tree that has poor wood condition. *City ownership of the trees recommended for removal should be verified prior to any removal*

Pruning Cycle

Proper pruning can extend the life and good health of trees, as well as reduce public safety issues. In the Management Needs section of the Findings there are four main maintenance issues to be addressed: routine pruning, crown cleaning, crown raising, and crown reduction. Crown cleaning removes dead, diseased, and damaged limbs. Crown raising is the removal of lower branches that are 2 inches in diameter or larger in the case of providing clearance for pedestrians or vehicles. Crown reduction is removing individual limbs from structures or utility wires. It is recommended that all trees be pruned on a routine schedule every five to seven years. Please refer to the six year maintenance plan for further information.

Planting

Most of the planting over the next 5 years will replace the trees that are removed. It is recommended to plant 1.2 trees for every tree removed, since survival rates will not be 100%. Please refer to the six year maintenance plan at the end of this section. It is not essential that the new trees be planted in the same location of the trees being removed. However, maintaining the same number of trees helps ensure continuation of the benefits of the existing forest in Agency.

It is important to plant a diverse mix of species in the urban forest to maintain canopy health, since most insects and diseases target a genus (ash) or species (green ash) of trees. Current diversity recommendations advise that a genus (i.e. maple, oak) not make up more than 20% of the urban forest and a single species (i.e. silver maple, sugar maple, white oak, bur oak) not make up more than 10% of the total urban forest. Presently, the forest is heavily planted with maple (32%) (Appendix A, Figure 1). Maples should not be planted until this percentage can be lowered. Also, ash trees have not been recommended since 2002, due to the threat of EAB. Other species to avoid because they are public nuisances include: cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut. It is recommended that Agency adopt city ordinances specifying trees that are allowed to be planted and that all trees planted must meet the restrictions in ordinance. (See sample ordinances, Appendix C).

Continual Monitoring

Due to the threat of EAB, it is important to continuously check the health of ash trees. It is recommended that ash trees be checked with a visual survey every year for tree decline and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Six Year Maintenance Plan recommendation

Year 1

      Removal: 2 critical concern trees

      Planting and Replacement: 3 trees to be planted in open locations

      Visual Survey for signs and symptoms of EAB

Year 2

      Removal: 2 trees- any new critical concern trees and ash trees with poor health

      Planting and Replacement: 3 trees in open locations from year one removals

      Routine trimming: Contract to trim 1/3 of the city trees

      Visual Survey for signs and symptoms of EAB

Year 3

      Removal: 2 trees - removal of any new critical concern trees and ash in poor health

      Planting and Replacement: 3 trees to be planted in open locations and locations from previous removals

      Visual Survey for signs and symptoms of EAB

Year 4

      Removal: 2 trees - removal of any new critical concern trees and ash in poor health

      Planting and Replacement: 3 trees in open locations from previous removals

      Routine trimming: Contract to trim 1/3 of the city trees

      Visual Survey for signs and symptoms of EAB

Year 5

      Removal: 2 trees - removal of any new critical concern trees and ash in poor health

      Planting and Replacement: 3 trees to be planted in open locations and locations from previous removals

      Visual Survey for signs and symptoms of EAB

Year 6

      Removal: 2 trees - removal of any new critical concern trees and ash in poor health

      Planting and Replacement: 3 trees in open locations from previous removals

      Routine trimming: Contract to trim 1/3 of the city trees

      Visual Survey for signs and symptoms of EAB

*Reduction of ash over 6 years: All ash needing removal should have been removed. EAB could potentially kill all ash within 4 years of its arrival.

**To remove all ash trees and critical/immediate concern trees within 6 years, maintain existing trees, and plant replacement trees, the budget would need to be approximately $1,750 per year.

Emerald Ash Borer Plan_____

Ash Tree Removal

Tree removal will be prioritized with dead, dying, hazardous trees to be removed first (Appendix B, Figure 4). Next will be all ash in poor condition and displaying signs and symptoms of EAB (Appendix B, Figure 2 & Appendix B, Figure 3). *City ownership of the tree recommended for removal should be verified prior to any removal*

Treatment of Ash Trees

Chemical treatment can be effective tool for communities to spread removal costs out over several years while allowing trees to continue to provide benefits. However, treatment is not recommended if EAB is more than 15 miles away from the community. For more information on the cost of treatment strategies visit http://extension.entm.purdue.edu/treecomputer/

EAB Quarantines

EAB is an extremely destructive plant pest and it is responsible for the death and decline of millions of ash trees. Ash in both forested and urban settings constitute a significant portion of the canopy cover in the United States. Current tools to detect, control, suppress and eradicate this pest are not as robust as the USDA would desire. In order to stay ahead of this hard to detect beetle, the USDA is attempting to contain the beetle before it spreads beyond its known positions by regulating articles.

A regulated article under the USDA's quarantine includes any of the following items:
• emerald ash borer
• firewood of all hardwood species (for example ash, oak, maple and hickory)
• nursery stock and green lumber of ash
• any other ash material, whether living, dead, cut or fallen, including logs, stumps, roots, branches, as well as composted and not composted chips of the genus ash (Mountain ash is not included)

In addition, any other article, product or means of conveyance not listed above may be designated as a regulated article if a USDA inspector determines that it presents a risk of spreading EAB once a quarantine is in effect for your county.

Wood Disposal

 A very important aspect of planning is determining how wood infested with EAB will be handled, keeping in mind that quarantines will restrict its movement. Consider who will cut and haul the dead and dying trees? Is there an accessible, secured site big enough to store and sort the hundreds of trees and the associated brush and chips? How will wood be disposed of or utilized? Do you have equipment capable of handling the amount and size of ash trees your tree inventory has identified? Once your county is under quarantine for EAB, contact USDA-APHIS-PPQ at 515-251-4083 or visit the website http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml.

Wood waste can be disposed of as you normally would if your county is not part of a quarantine.

Canopy Replacement

As budget permits, all removed trees will be replaced. All trees will meet the restrictions in city ordinance. (Appendix C). The new plantings will be a diverse mix and will not include ash, maple, cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

Postponed Work

While finances, staffing and equipment are focused on the management of ash, usual services may be delayed. Tree removal requests on genera other than ash will be prioritized by hazardous or emergency situations only.

Monitoring

It is recommended that ash trees be checked with a visual survey every year for tree death and for the following signs and symptoms: canopy dieback, epicormic shoots, bark splitting, D-shaped borer exit holes, and wood pecker damage.

Private Ash Trees

It is strongly recommended that private property owners start removing ash trees on their property upon arrival of EAB. Sample City Code 151.06 (Appendix C) states "If it is determined with reasonable certainty that any such condition exists (trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests) on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property."

Budget _____

Estimated Budget Needs
Total $10,500 over 6 years ($1,750/year)

FY 2015 Budget
  Removal: $1,000
  Planting: $300
  Watering & Maintenance: $200
FY 2016 Budget
  Removal: $1,000
  Planting: $300
  Routine trimming: $500
  Watering & Maintenance: $200
FY 2017 Budget
  Removal: $1,000
  Planting: $300
  Watering & Maintenance: $200
FY 2018 Budget
  Removal: $1,000
  Planting: $300
  Routine trimming: $500
  Watering & Maintenance: $200
FY 2019 Budget
  Removal: $1,000
  Planting: $300
  Watering & Maintenance: $200
FY 2020 Budget
  Removal: $1,000
  Planting: $300
  Routine trimming: $500
  Watering & Maintenance: $200

Purposed Budget Increase
EAB could potentially kill all ash trees in Agency within 4 years of its arrival. To remove all ash trees and critical/immediate concern trees within 6 years, maintain existing trees, and plant replacement trees, the budget would need to be approximately $1,750 per year. Additionally, it is recommended that Agency apply for grants to fund replacement trees. Utility Company grants are usually between $500 and $10,000 for community-based, tree-planting projects that include parks, gateways, cemeteries, nature trails, libraries, nursing homes, and schools.

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Appendix A: i-Tree Data

Table 1: Annual Energy Benefits

Agency

Annual Energy Benefits of Public Trees

1/22/2015

Species	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	6.6	498	845.2	828	1,326	(N/A)	19.6	31.8	63.15
Green ash	2.6	198	331.4	325	523	(N/A)	9.3	12.5	52.30
Black locust	2.2	167	326.1	320	487	(N/A)	9.3	11.7	48.67
Eastern redbud	0.6	48	101.7	100	147	(N/A)	6.5	3.5	21.04
Norway maple	1.3	99	174.4	171	270	(N/A)	5.6	6.5	45.04
Apple	0.4	30	68.0	67	96	(N/A)	5.6	2.3	16.06
Northern white cedar	0.1	9	19.9	19	28	(N/A)	4.7	0.7	5.61
Eastern red cedar	0.5	35	68.2	67	102	(N/A)	4.7	2.4	20.38
Black walnut	0.7	54	103.7	102	156	(N/A)	3.7	3.7	38.98
Broadleaf Deciduous Large	0.5	34	58.1	57	91	(N/A)	3.7	2.2	22.83
Red maple	0.5	36	63.1	62	98	(N/A)	2.8	2.4	32.70
Siberian elm	0.4	32	54.1	53	85	(N/A)	2.8	2.0	28.42
Mulberry	0.1	11	25.7	25	36	(N/A)	1.9	0.9	18.19
Blue spruce	0.1	4	9.7	10	14	(N/A)	1.9	0.3	6.94
Honeylocust	0.6	47	84.6	83	130	(N/A)	1.9	3.1	64.79
Callery pear	0.1	6	12.4	12	18	(N/A)	1.9	0.4	8.99
Catalpa	0.2	14	27.5	27	41	(N/A)	1.9	1.0	20.64
Boxelder	0.4	32	59.2	58	90	(N/A)	1.9	2.2	45.11
Sugar maple	0.5	39	73.4	72	111	(N/A)	1.9	2.7	55.65
Black cherry	0.2	14	24.7	24	38	(N/A)	0.9	0.9	38.13
Northern pin oak	0.2	18	29.5	29	47	(N/A)	0.9	1.1	46.78
Broadleaf Deciduous Small	0.0	2	3.8	4	5	(N/A)	0.9	0.1	5.40
Northern hackberry	0.1	9	19.1	19	28	(N/A)	0.9	0.7	27.70
American sycamore	0.2	18	27.0	26	44	(N/A)	0.9	1.1	44.23
Eastern white pine	0.0	2	4.0	4	6	(N/A)	0.9	0.1	5.61
Sweetgum	0.0	0	0.5	0	1	(N/A)	0.9	0.0	0.66
Bur oak	0.4	33	59.0	58	91	(N/A)	0.9	2.2	91.02
American elm	0.3	22	41.8	41	63	(N/A)	0.9	1.5	62.70
Total	19.9	1,512	2,715.4	2,661	4,173	(N/A)	100.0	100.0	39.00

Table 2: Annual Stormwater Benefits

Agency

Annual Stormwater Benefits of Public Trees

1/22/2015

Species	Total rainfall interception (Gal)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	84,865	2,300	(N/A)	19.6	42.1	109.52
Green ash	26,964	731	(N/A)	9.3	13.4	73.07
Black locust	21,290	577	(N/A)	9.3	10.6	57.69
Eastern redbud	2,253	61	(N/A)	6.5	1.1	8.72
Norway maple	8,702	236	(N/A)	5.6	4.3	39.30
Apple	1,391	38	(N/A)	5.6	0.7	6.28
Northern white cedar	1,064	29	(N/A)	4.7	0.5	5.77
Eastern red cedar	6,722	182	(N/A)	4.7	3.3	36.43
Black walnut	6,397	173	(N/A)	3.7	3.2	43.34
Broadleaf Deciduous Large	2,853	77	(N/A)	3.7	1.4	19.33
Red maple	2,854	77	(N/A)	2.8	1.4	25.79
Siberian elm	2,611	71	(N/A)	2.8	1.3	23.59
Mulberry	529	14	(N/A)	1.9	0.3	7.17
Blue spruce	513	14	(N/A)	1.9	0.3	6.95
Honeylocust	5,810	157	(N/A)	1.9	2.9	78.73
Callery pear	325	9	(N/A)	1.9	0.2	4.41
Catalpa	1,216	33	(N/A)	1.9	0.6	16.47
Boxelder	5,764	156	(N/A)	1.9	2.9	78.10
Sugar maple	4,933	134	(N/A)	1.9	2.4	66.84
Black cherry	667	18	(N/A)	0.9	0.3	18.06
Northern pin oak	1,409	38	(N/A)	0.9	0.7	38.19
Broadleaf Deciduous Small	69	2	(N/A)	0.9	0.0	1.86
Northern hackberry	617	17	(N/A)	0.9	0.3	16.73
American sycamore	1,466	40	(N/A)	0.9	0.7	39.72
Eastern white pine	213	6	(N/A)	0.9	0.1	5.77
Sweetgum	18	0	(N/A)	0.9	0.0	0.48
Bur oak	7,239	196	(N/A)	0.9	3.6	196.17
American elm	2,779	75	(N/A)	0.9	1.4	75.32
Citywide total	201,532	5,462	(N/A)	100.0	100.0	51.04

Table 3: Annual Air Quality Benefits

Annual Air Quality Benefits of Public Trees

1/22/2015

Species	Deposition (lb)				Total Depos. ($)	Avoided (lb)				Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($) Standard Error	% of Total Trees	Avg. $/tree
	O_3	NO_2	PM_{10}	SO_2		NO_2	PM_{10}	VOC	SO_2							
Silver maple	14.0	2.4	7.0	0.6	76	30.8	4.5	4.3	29.7	193	-7.6	-29	85.6	240 (N/A)	19.6	11.43
Green ash	3.8	0.6	1.8	0.2	20	12.2	1.8	1.7	11.8	77	0.0	0	34.0	97 (N/A)	9.3	9.72
Black locust	4.4	0.8	2.2	0.2	24	10.8	1.5	1.5	10.0	66	-1.0	-4	30.2	86 (N/A)	9.3	8.63
Eastern redbud	0.5	0.1	0.3	0.0	3	3.1	0.4	0.4	2.8	19	0.0	0	7.7	22 (N/A)	6.5	3.12
Norway maple	1.4	0.2	0.7	0.1	8	6.2	0.9	0.9	5.9	39	-0.4	-1	16.0	45 (N/A)	5.6	7.55
Apple	0.2	0.0	0.1	0.0	1	2.0	0.3	0.3	1.8	12	0.0	0	4.7	13 (N/A)	5.6	2.24
Northern white cedar	0.0	0.0	0.1	0.0	0	0.6	0.1	0.1	0.5	3	-0.3	-1	1.1	3 (N/A)	4.7	0.56
Eastern red cedar	1.4	0.3	1.1	0.2	9	2.2	0.3	0.3	2.1	14	-3.7	-14	4.2	9 (N/A)	4.7	1.79
Black walnut	0.6	0.1	0.3	0.0	3	3.5	0.5	0.5	3.2	21	0.0	0	8.7	25 (N/A)	3.7	6.17
Broadleaf Deciduous Large	0.2	0.0	0.1	0.0	1	2.1	0.3	0.3	2.1	13	0.0	0	5.1	14 (N/A)	3.7	3.57
Red maple	0.5	0.1	0.2	0.0	3	2.3	0.3	0.3	2.2	14	-0.2	-1	5.7	16 (N/A)	2.8	5.34
Siberian elm	0.2	0.0	0.1	0.0	1	2.0	0.3	0.3	1.9	12	0.0	0	4.8	13 (N/A)	2.8	4.48
Mulberry	0.1	0.0	0.1	0.0	1	0.8	0.1	0.1	0.7	5	0.0	0	1.8	5 (N/A)	1.9	2.55
Blue spruce	0.0	0.0	0.0	0.0	0	0.3	0.0	0.0	0.3	2	-0.1	0	0.6	2 (N/A)	1.9	0.75
Honeylocust	1.1	0.2	0.5	0.0	6	2.9	0.4	0.4	2.8	18	-0.8	-3	7.6	21 (N/A)	1.9	10.61
Callery pear	0.0	0.0	0.0	0.0	0	0.4	0.1	0.1	0.3	2	0.0	0	0.9	2 (N/A)	1.9	1.21
Catalpa	0.0	0.0	0.0	0.0	0	0.9	0.1	0.1	0.9	6	0.0	0	2.1	6 (N/A)	1.9	2.99
Boxelder	0.8	0.1	0.4	0.0	4	2.0	0.3	0.3	1.9	13	-0.2	-1	5.7	16 (N/A)	1.9	8.15
Sugar maple	0.6	0.1	0.3	0.0	3	2.5	0.4	0.3	2.4	15	-0.5	-2	6.1	17 (N/A)	1.9	8.46
Black cherry	0.2	0.0	0.1	0.0	1	0.9	0.1	0.1	0.8	5	0.0	0	2.3	7 (N/A)	0.9	6.56
Northern pin oak	0.2	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	-0.1	0	2.8	8 (N/A)	0.9	7.92
Broadleaf Deciduous Small	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	0.0	0	0.3	1 (N/A)	0.9	0.71
Northern hackberry	0.0	0.0	0.0	0.0	0	0.6	0.1	0.1	0.5	4	0.0	0	1.4	4 (N/A)	0.9	3.84
American sycamore	0.1	0.0	0.1	0.0	1	1.1	0.2	0.2	1.1	7	0.0	0	2.6	7 (N/A)	0.9	7.42
Eastern white pine	0.0	0.0	0.0	0.0	0	0.1	0.0	0.0	0.1	1	-0.1	0	0.2	1 (N/A)	0.9	0.56
Sweetgum	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0 (N/A)	0.9	0.08
Bur oak	1.2	0.2	0.5	0.1	6	2.1	0.3	0.3	2.0	13	0.0	0	6.6	19 (N/A)	0.9	19.04
American elm	0.2	0.0	0.1	0.0	1	1.4	0.2	0.2	1.3	9	0.0	0	3.5	10 (N/A)	0.9	9.99
Citywide total	31.8	5.4	16.3	1.5	174	94.9	13.8	13.2	90.3	592	-14.9	-56	252.4	710 (N/A)	100.0	6.63

Table 4: Annual Carbon Stored

Stored CO2 Benefits of Public Trees

1/22/2015

Species	Total Stored CO_2 (lbs)	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	325,083	2,438	(N/A)	19.6	44.4	116.10
Green ash	131,441	986	(N/A)	9.3	18.0	98.58
Black locust	73,093	548	(N/A)	9.3	10.0	54.82
Eastern redbud	8,485	64	(N/A)	6.5	1.2	9.09
Norway maple	23,543	177	(N/A)	5.6	3.2	29.43
Apple	4,717	35	(N/A)	5.6	0.6	5.90
Northern white cedar	191	1	(N/A)	4.7	0.0	0.29
Eastern red cedar	4,451	33	(N/A)	4.7	0.6	6.68
Black walnut	18,984	142	(N/A)	3.7	2.6	35.60
Broadleaf Deciduous	5,926	44	(N/A)	3.7	0.8	11.11
Red maple	5,825	44	(N/A)	2.8	0.8	14.56
Siberian elm	4,853	36	(N/A)	2.8	0.7	12.13
Mulberry	1,816	14	(N/A)	1.9	0.2	6.81
Blue spruce	86	1	(N/A)	1.9	0.0	0.32
Honeylocust	13,485	101	(N/A)	1.9	1.8	50.57
Callery pear	437	3	(N/A)	1.9	0.1	1.64
Catalpa	2,069	16	(N/A)	1.9	0.3	7.76
Boxelder	34,775	261	(N/A)	1.9	4.7	130.41
Sugar maple	15,891	119	(N/A)	1.9	2.2	59.59
Black cherry	3,037	23	(N/A)	0.9	0.4	22.78
Northern pin oak	3,624	27	(N/A)	0.9	0.5	27.18
Broadleaf Deciduous	178	1	(N/A)	0.9	0.0	1.33
Northern hackberry	426	3	(N/A)	0.9	0.1	3.19
American sycamore	3,672	28	(N/A)	0.9	0.5	27.54
Eastern white pine	38	0	(N/A)	0.9	0.0	0.29
Sweetgum	12	0	(N/A)	0.9	0.0	0.09
Bur oak	39,259	294	(N/A)	0.9	5.4	294.44
American elm	6,743	51	(N/A)	0.9	0.9	50.57
Citywide total	732,139	5,491	(N/A)	100.0	100.0	51.32

Table 5: Annual Carbon Sequestered

Agency

1/22/2015

Species	Sequestered (lb)	Sequestered ($)	Decomposition Release (lb)	Maintenance Release (lb)	Total Released ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total Standard ($) Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	25,177	189	-1,560	-69	-1	0	0	23,547	177 (N/A)	19.6	51.6	8.41
Green ash	4,892	37	-631	-27	0	0	0	4,235	32 (N/A)	9.3	9.3	3.18
Black locust	2,862	21	-351	-24	0	0	0	2,487	19 (N/A)	9.3	5.4	1.87
Eastern redbud	951	7	-41	-9	0	0	0	901	7 (N/A)	6.5	2.0	0.97
Norway maple	2,238	17	-113	-12	0	0	0	2,113	16 (N/A)	5.6	4.6	2.64
Apple	607	5	-23	-6	0	0	0	578	4 (N/A)	5.6	1.3	0.72
Northern white cedar	90	1	-1	-3	0	0	0	86	1 (N/A)	4.7	0.2	0.13
Eastern red cedar	142	1	-21	-8	0	0	0	112	1 (N/A)	4.7	0.2	0.17
Black walnut	1,737	13	-91	-8	0	0	0	1,638	12 (N/A)	3.7	3.6	3.07
Broadleaf Deciduous Large	937	7	-28	-5	0	0	0	904	7 (N/A)	3.7	2.0	1.69
Red maple	814	6	-28	-4	0	0	0	781	6 (N/A)	2.8	1.7	1.95
Siberian elm	637	5	-23	-4	0	0	0	609	5 (N/A)	2.8	1.3	1.52
Mulberry	228	2	-9	-2	0	0	0	217	2 (N/A)	1.9	0.5	0.81
Blue spruce	24	0	0	-1	0	0	0	23	0 (N/A)	1.9	0.0	0.08
Honeylocust	1,873	14	-65	-5	0	0	0	1,803	14 (N/A)	1.9	3.9	6.76
Callery pear	191	1	-3	-1	0	0	0	187	1 (N/A)	1.9	0.4	0.70
Catalpa	418	3	-10	-2	0	0	0	405	3 (N/A)	1.9	0.9	1.52
Boxelder	2,053	15	-167	-6	0	0	0	1,880	14 (N/A)	1.9	4.1	7.05
Sugar maple	1,045	8	-76	-5	0	0	0	963	7 (N/A)	1.9	2.1	3.61
Black cherry	268	2	-15	-2	0	0	0	251	2 (N/A)	0.9	0.5	1.88
Northern pin oak	386	3	-17	-2	0	0	0	367	3 (N/A)	0.9	0.8	2.75
Broadleaf Deciduous Small	38	0	-1	-1	0	0	0	37	0 (N/A)	0.9	0.1	0.27
Northern hackberry	78	1	-2	-1	0	0	0	75	1 (N/A)	0.9	0.2	0.56
American sycamore	445	3	-18	-2	0	0	0	426	3 (N/A)	0.9	0.9	3.19
Eastern white pine	18	0	0	-1	0	0	0	17	0 (N/A)	0.9	0.0	0.13
Sweetgum	3	0	0	0	0	0	0	2	0 (N/A)	0.9	0.0	0.02
Bur oak	912	7	-188	-5	0	0	0	719	5 (N/A)	0.9	1.6	5.39
American elm	342	3	-32	-3	0	0	0	307	2 (N/A)	0.9	0.7	2.30
Citywide total	49,405	371	-3,516	-220	-2	0	0	45,669	343 (N/A)	100.0	100.0	3.20

Table 6: Annual Social and Aesthetic Benefits

Agency

Annual Aesthetic/Other Benefits of Public Trees

1/22/2015

Species	Total ($)	Standard Error	% of Total Trees	% of Total $	Avg. $/tree
Silver maple	2,022	(N/A)	19.6	43.6	96.28
Green ash	439	(N/A)	9.3	9.5	43.89
Black locust	281	(N/A)	9.3	6.1	28.15
Eastern redbud	54	(N/A)	6.5	1.2	7.70
Norway maple	226	(N/A)	5.6	4.9	37.65
Apple	34	(N/A)	5.6	0.7	5.68
Northern white cedar	34	(N/A)	4.7	0.7	6.83
Eastern red cedar	54	(N/A)	4.7	1.2	10.88
Black walnut	172	(N/A)	3.7	3.7	43.12
Broadleaf Deciduous Large	118	(N/A)	3.7	2.5	29.43
Red maple	126	(N/A)	2.8	2.7	41.85
Siberian elm	76	(N/A)	2.8	1.6	25.37
Mulberry	13	(N/A)	1.9	0.3	6.40
Blue spruce	25	(N/A)	1.9	0.5	12.31
Honeylocust	389	(N/A)	1.9	8.4	194.60
Callery pear	26	(N/A)	1.9	0.6	12.89
Catalpa	57	(N/A)	1.9	1.2	28.56
Boxelder	122	(N/A)	1.9	2.6	61.22
Sugar maple	117	(N/A)	1.9	2.5	58.58
Black cherry	15	(N/A)	0.9	0.3	15.48
Northern pin oak	39	(N/A)	0.9	0.8	39.16
Broadleaf Deciduous Small	2	(N/A)	0.9	0.0	2.06
Northern hackberry	24	(N/A)	0.9	0.5	24.25
American sycamore	46	(N/A)	0.9	1.0	45.86
Eastern white pine	7	(N/A)	0.9	0.1	6.83
Sweetgum	5	(N/A)	0.9	0.1	5.26
Bur oak	58	(N/A)	0.9	1.3	58.34
American elm	51	(N/A)	0.9	1.1	51.00
Citywide total	4,634	(N/A)	100.0	100.0	43.31

Table 7: Summary of Benefits in Dollars

Agency

Total Annual Benefits of Public Trees by Species ($)

1/22/2015

Species	Energy	CO_2	Air Quality	Stormwater	Aesthetic/Other	Total ($)	Standard Error	% of Total $
Silver maple	1,326	177	240	2,300	2,022	6,065	(N/A)	39.6
Green ash	523	32	97	731	439	1,822	(N/A)	11.9
Black locust	487	19	86	577	281	1,450	(N/A)	9.5
Eastern redbud	147	7	22	61	54	291	(N/A)	1.9
Norway maple	270	16	45	236	226	793	(N/A)	5.2
Apple	96	4	13	38	34	186	(N/A)	1.2
Northern white cedar	28	1	3	29	34	94	(N/A)	0.6
Eastern red cedar	102	1	9	182	54	348	(N/A)	2.3
Black walnut	156	12	25	173	172	539	(N/A)	3.5
Broadleaf Deciduous La	91	7	14	77	118	307	(N/A)	2.0
Red maple	98	6	16	77	126	323	(N/A)	2.1
Siberian elm	85	5	13	71	76	250	(N/A)	1.6
Mulberry	36	2	5	14	13	70	(N/A)	0.5
Blue spruce	14	0	2	14	25	54	(N/A)	0.4
Honeylocust	130	14	21	157	389	711	(N/A)	4.6
Callery pear	18	1	2	9	26	56	(N/A)	0.4
Catalpa	41	3	6	33	57	140	(N/A)	0.9
Boxelder	90	14	16	156	122	399	(N/A)	2.6
Sugar maple	111	7	17	134	117	386	(N/A)	2.5
Black cherry	38	2	7	18	15	80	(N/A)	0.5
Northern pin oak	47	3	8	38	39	135	(N/A)	0.9
Broadleaf Deciduous Sn	5	0	1	2	2	10	(N/A)	0.1
Northern hackberry	28	1	4	17	24	73	(N/A)	0.5
American sycamore	44	3	7	40	46	140	(N/A)	0.9
Eastern white pine	6	0	1	6	7	19	(N/A)	0.1
Sweetgum	1	0	0	0	5	7	(N/A)	0.0
Bur oak	91	5	19	196	58	370	(N/A)	2.4
American elm	63	2	10	75	51	201	(N/A)	1.3
Citywide Total	4,173	343	710	5,462	4,634	15,321	(N/A)	100.0
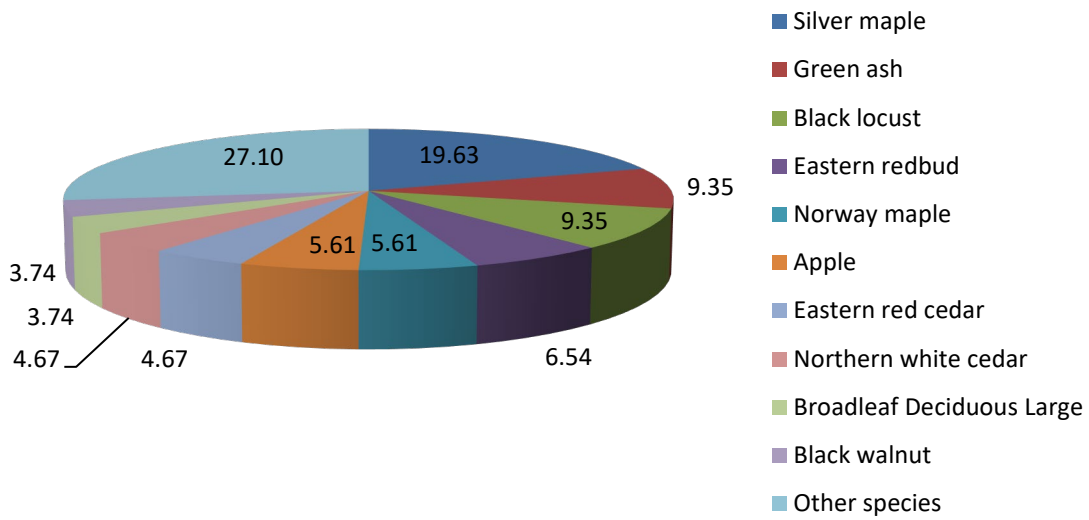
Figure 1: Species Distribution

# Relative Age Distribution of Top 10 Public Tree Species (%)
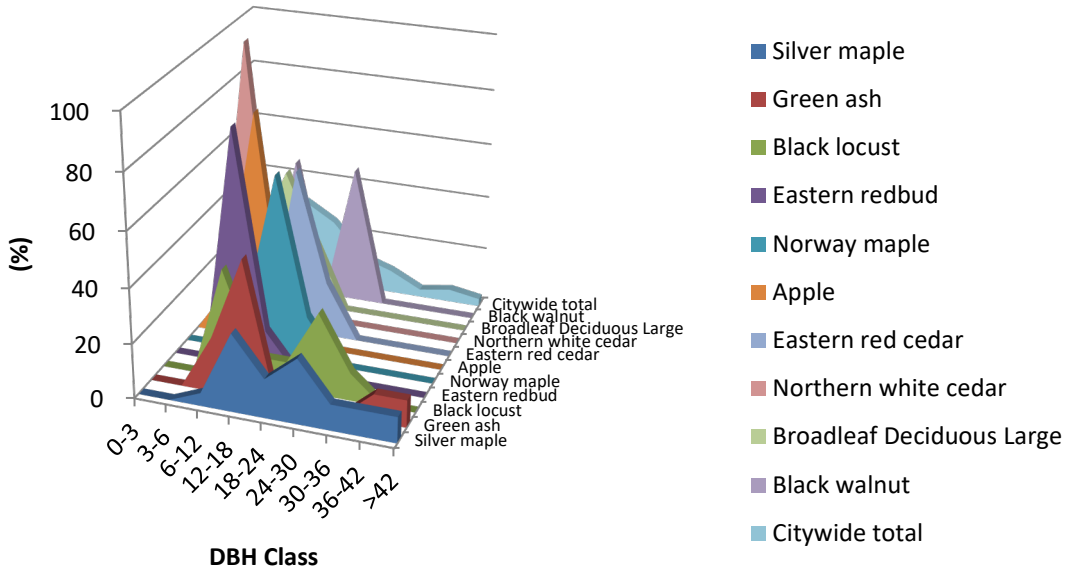
Figure 2: Relative Age Class

Leaf Condition

Dead or Dying
1%

Poor
0%

Fair
4%

Good
95%

- Dead or Dying
- Poor
- Fair
- Good
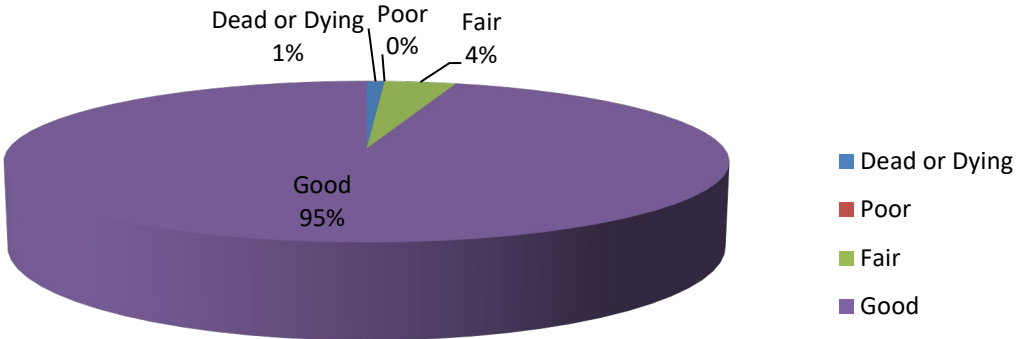
Figure 3: Foliage Condition

Wood Condition

Dead or Dying
1%

Poor
1%

Fair
16%

Good
82%

- Dead or Dying
- Poor
- Fair
- Good
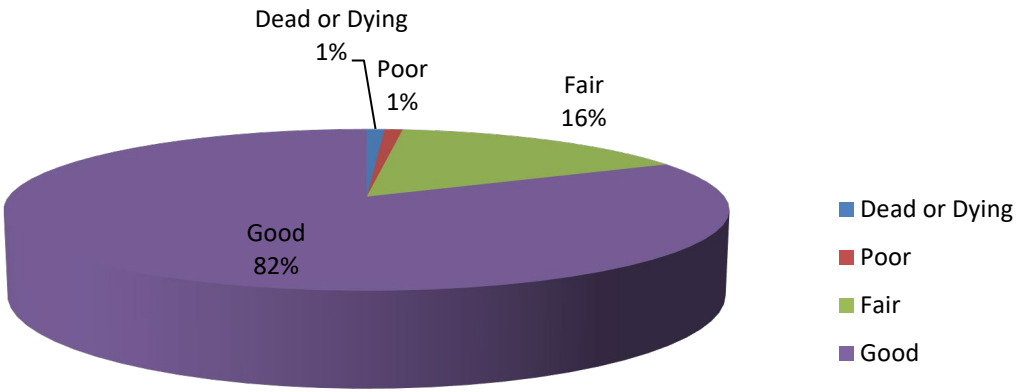
Figure 4: Wood Condition

Canopy Cover
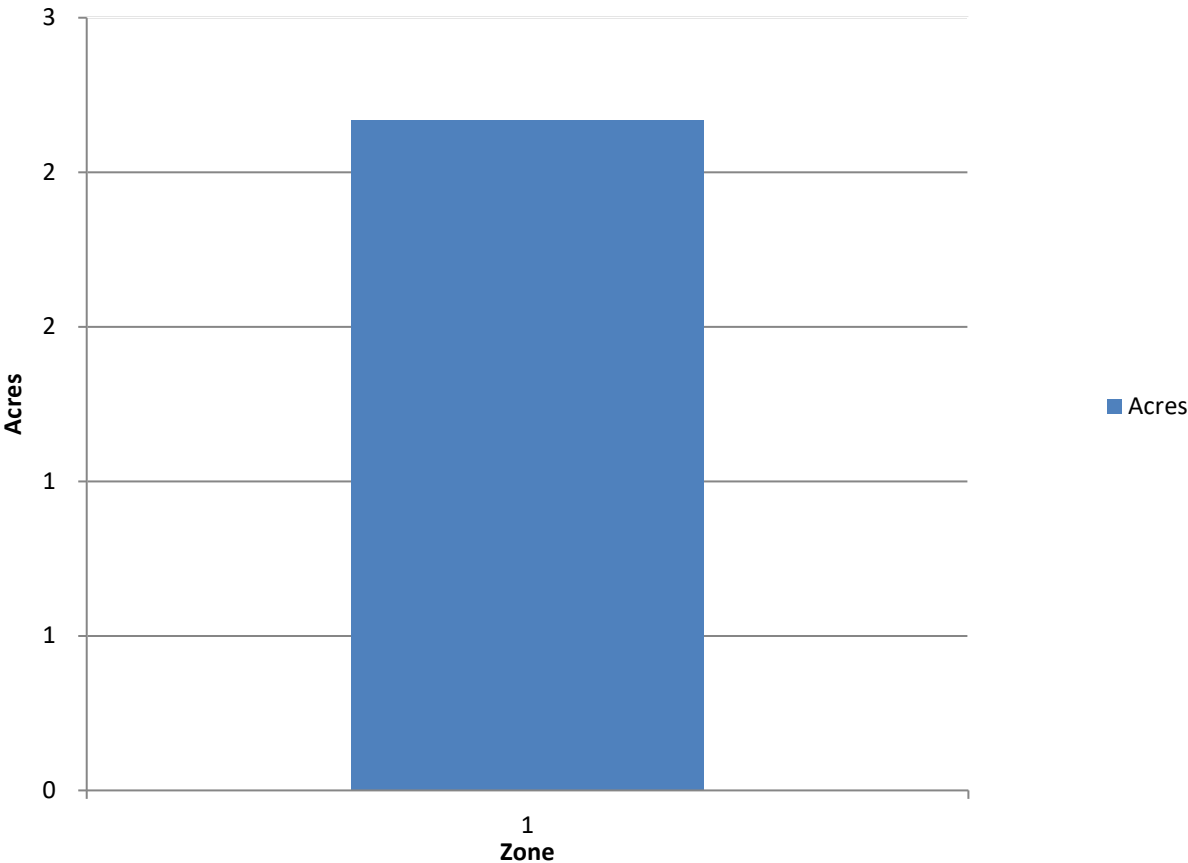
Figure 5: Canopy Cover in Acres

Land use Public Trees by Zone (%)
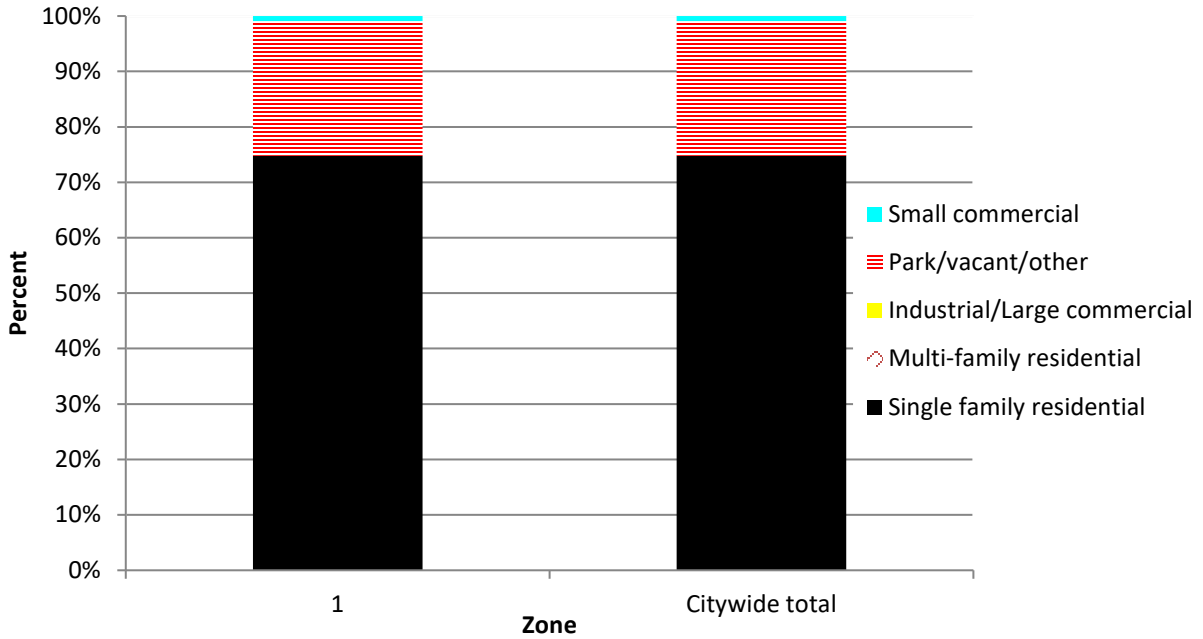
Figure 6: Land Use of city/park trees

Location Public Trees by Zone (%)
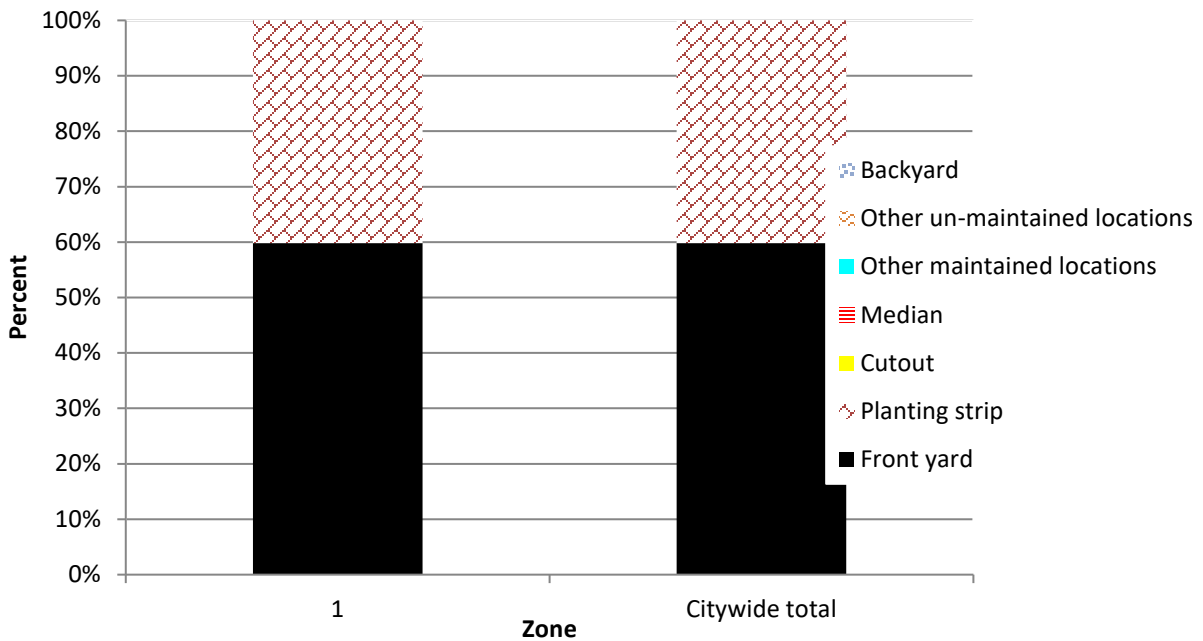
Figure 7: Location of city/park trees

Appendix B: ArcGIS Mapping

Figure 1: Location of Ash Trees

Figure 2: Location of EAB symptoms

Figure 3: Location of Poor Condition Trees

Figure 4: Location of Trees with Recommended Maintenance

Figure 5: Maintenance Tasks ***City ownership of the trees recommended for removal should be verified prior to any removal***

Appendix C: "Sample" Tree Ordinances

CHAPTER 151
TREES AND GRASS

151.01 DEFINITION. For use in this chapter, "boulevard" means that part of the street, avenue or highway in the City not covered by sidewalk and lying between the lot line and the curb line; or, on unpaved streets, that part of the street, avenue or highway lying between the lot line and that portion of the street usually traveled by vehicular traffic.

151.02 PLANTING RESTRICTIONS. No tree shall be planted in any boulevard or street except in accordance with the following:
1. Alignment. All tress planted in any street shall be planted in the boulevard midway between the outer line of the sidewalk and the curb. In the event a curb line is not established, trees shall be planted on a line ten (10) feet from the property line.
2. Spacing. Trees shall not be planted on any boulevard which is less than nine (9) feet in width, or contains less than eighty-one (81) square feet of exposed soil surface per tree. Trees shall not be planted closer than twenty (20) feet from street intersections (property lines extended) and ten (10) feet from driveways. If it is at all possible trees should be planted inside the property lines and not between the sidewalk and the curb.
3. Prohibited Trees. No person shall plant in any street any fruit-bearing tree or any tree of the kinds commonly known as cottonwood, poplar, box elder, Chinese elm, evergreen, willow or black walnut.

151.03 DUTY TO TRIM TREES. The owner or agent of the abutting property shall keep the trees on, or overhanging the street, trimmed so that all branches will be at least eighteen (18) feet above the surface of a street, twenty (20) feet above the surface of a primary highway, and eight (8) feet above the sidewalks. If the abutting property owner fails to trim the trees, the City may serve notice on the abutting property owner requiring that such action be taken within five (5) days. If such action is not taken within that time, the
City may perform the required action and assess the costs against the abutting property for collection in the same manner as a property tax.
(Code of Iowa, Sec. 364.12[2c, d, & e])

151.04 TRIMMING TREES TO BE SUPERVISED. Except as allowed in Section 151.03, it is unlawful for any person to trim or cut any tree in a street or public place unless the work is done under the supervision of the City.

151.05 DISEASE CONTROL. Any dead, diseased or damaged tree or shrub which may harbor serious insect or disease pests or disease injurious to other trees is hereby declared to be a nuisance.

151.06 INSPECTION AND REMOVAL. The Council shall inspect or cause to be inspected any trees or shrubs in the City reported or suspected to be infected with or damaged by any disease or insect or disease pests, and such trees and shrubs shall be subject to removal as follows:
1. City Property. If it is determined that any such condition exists on any public property, including the strip between the curb and the lot line of private property, the Council may cause such condition to be corrected by treatment or removal. The Council may also order the removal of any trees on the streets of the City which interfere with the making of improvements or with travel thereon.
2. Private Property. If it is determined with reasonable certainty that any such condition exists on private property and that the danger to other trees or to adjoining property or passing motorists or pedestrians is imminent, the Council shall notify by certified mail the owner, occupant or person in charge of such property to correct such condition by treatment or removal within fourteen (14) days of said notification. If such owner, occupant or person in charge of said property fails to comply within 14 days of receipt of notice, the Council may cause the condition to be corrected and the cost assessed against the property.
(Code of Iowa, Sec. 364.12[3b & h])

151.07 CUTTING OR MOWING OF GRASS.
1. Duty to Cut and Mow Lawns and Lots. The owner of any property shall cut and mow all lawns and lots so that such growth shall be less than four (4) inches at all times.
2. Cutting and Mowing by City. If a property owner refuses or fails to cut and mow lawns and lots within forty-eight (48) hours after being delivered a notice from the City to perform such action, the Council may require said work to be done and the cost and expenses thereof shall be assessed to the property owner after due notice is given. The amount of such assessment shall be certified to the County Auditor as provided by law and the same shall be collected with and in the same manner as general property taxes.

'Sample' Recommended Planting List:

Common Name	Scientific Name	Cultivars/ Selections
Shade Trees		
Black Maple	*Acer nigrum*	
Red Maple	*Acer rubrum*	Burgundy Belle, Red Sunset, Scarlet Jewel, Redpoint, Somerset
Sugar Maple	*Acer saccharum*	Commemoration, Crescendo, Endowment, Fall Fiesta, Legacy, Green Mountain
Hackberry	*Celtis occidentalis*	Chicagoland, Prairie Pride, Windy City
Yellowwood	*Cladrastis kentuckea*	
Ginkgo (male only)	*Ginkgo biloba*	Autumn Gold, Golden Colonnade, Halka, Magyar, Presidential Gold, Princeton Sentry
Thornless Honeylocust	*Gleditisia triacanthos*	Northern Acclaim, Skyline, Shademaster
Kentucky Coffeetree	*Gymnocladus dioicus*	
Larch	*Larix decidua*	
American Hophornbeam	*Ostrya virginiana*	
London Planetree	*Platanus x acerfolia*	Bloodgood
Corktree (male only)	*Phellodendron spp.*	Macho, Longenecker, Eye Stopper and His Majesty
White Oak	*Quercus alba*	
Swamp White Oak	*Quercus bicolor*	
Shingle Oak	*Quercus imbricaria*	
Bur Oak	*Quercus macrocarpa*	
Chinkapin Oak	*Quercus muehlenbergii*	
English Oak	*Quercus robur*	
Northern Red Oak	*Quercus rubra*	
Bald Cypress	*Taxodium distichum*	
American Linden	*Tilia americana*	Boulevard, Front Yard, Legend
Silver Linden	*Tillia tomemtosa*	
Low Growing Trees		
Serviceberry	*Amelanchier spp.*	Autumn Brilliance, Cole's Select, Cumulus, Princess Diana, Strata
American Hornbeam	*Carpinus caroliniana*	
Eastern Redbud	*Cercis canadensis*	
Pagoda Dogwood	*Cornus alternifolia*	
Flowering Crabapple	*Malus spp.*	Adirondack, Cardinal, David, Donald Wyman, Doublooms, Florbunda, Golden Raindrops, Harvest Gold, Indian Magic, Louisa, Mary Potter, Purple Prince, Red Jewel, Royal Fountain, Royal Raindrops, Sugar Tyme
Japanese Tree Lilac	*Syringa reticulata*	Ivory Silk, Summer Snow

Parks only Conifers		
White Fir	*Abies concolor*	
Norway Spruce	*Picea abies*	
White Spruce	*Picea glauca*	
Black Hills Spruce	*Picea glauca var. densata*	
Serbian Spruce	*Picea omorika*	
White Pine	*Pinus strobus*	
Arborvitae	*Thuja occidentalis*	
Eastern Hemlock	*Tsuga canadensis*	